

FIGHT'S ON!

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Air Force Research Laboratory Human Effectiveness Directorate (AFRL/HEA)

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Mesa's Modeling & Simulation Innovations = International Impact

USAF Modeling & Simulation Caucus Applauds Mesa's Innovations

Recognized internationally for world-class training research and development (R&D), and by USAF senior leadership as the R&D innovation center for Distributed Mission Operations (DMO) training research, the Warfighter Training Research Division headquartered in Mesa, Arizona hosted the USAF Modeling & Simulation (M&S) Caucus' June 2003 meeting. Featured Mesa Research Site (MRS) demonstrations expounded on a host of training technologies and methods to raise the standards of systems acquired for the Combat Air Force (CAF), including Mission Training Centers (MTC).

Mesa's early M&S leadership in Distributed Mission Training (DMT) traces to the 1970s, but the momentum April 1997 DMT demonstration in Las Vegas at the *Air Force 50th Anniversary* exposition put MRS on the M&S map and paved the way for the CAF's journey toward DMO.

Current visual display systems embedded in fast-jet MTC simulators are based on early research designs developed at MRS, but Caucus attendees learned firsthand how the revolutionary Mobile Modular Display for Advanced Research and Training (M2DART) design continues to capitalize on visual display technology

improvements. With four Block 30 F-16C "Viper" Multi-Task Trainers (MTT) housed in M2DARTs with cutting-edge visuals, Caucus attendees witnessed operational pilots fly air combat scenarios under control of a Weapons Director.



Lt Gen Leslie Kenne, AF/XI (Deputy Chief of Staff, Warfighting Integration), presents the 2002 Air Force Modeling & Simulation Award for Training to the principal scientist, Dr. Wink Bennett, on behalf of government, military, and contractor colleagues on the AFRL/HEAS Training Systems Technology Team

Technologies in the M2DART enable 360-degree visual immersion, but are adaptable to support front-aspect visuals for space-limited simulators. M2DART configurations, including some scaled-down versions, have transitioned to A-10 Full Mission Trainers (FMT) currently in the field, the Air Force Flight Test Center, Defence R&D Canada (DRDC), and to the US Navy for development and evaluation under the Naval Aviation Simulation Master Plan.

The MTT, developed by Team Mesa as an open-architecture design, was the first deployable high-fidelity, low-cost full-mission fighter simulator. It was also the first simulator to convert the aircraft's operational flight program code to C/C++ language, resulting in the MTT operating exactly like the jet. Team Mesa marked another reuse transition success by migrating the Power-PC design to other simulators, such as a C-130, A-10s, F-15Es, Block 40 F-16s, and the CF-18 MTT prototype in development at MRS.

Caucus members noted the modular approach adds a true plug-and-play capability for maintaining simulator concurrency with the aircraft. This approach accommodates future visual display enhancements, and takes advantage of image generator (IG) and database improvements at much lower costs than "hard-wired" system designs. Operating at

a solid 60Hz visual out-the-window view with sensors perfectly correlated to the individual texture element level for high resolution, the modular method accommodates both high-end and PC-based IGs. In addition to enabling "cheaper, better, faster" system upgrades, the modular approach guarantees each component is inherently designed to integrate with networked DMT and DMO environments.

The Division helped forge CAF and US Navy simulation acquisition strategies. Research at MRS is the springboard for R&D programs aimed at incorporating command and control (C2) and intelligence, surveillance, and reconnaissance linkage vital to the “sensor-to-shooter” Kill Chain. By closely working with front-line CAF warfighters, the Division’s leadership helped the Training Systems Technology Team garner the 2002 Air Force M&S Award for Training. In presenting the award, Lt Gen Kenne noted the Team’s many M&S successes and lauded MRS leadership for “Very impressive...great contributions to warfighting programs.”

Impact on the International Front

Canadian scientists, engineers, and SMEs made recurring visits to MRS under the US/Canadian Project Arrangement concerning Advanced DMT Technologies. The proven plug-and-play technologies in the M2DART configuration prompted DRDC leadership to explore extended visual research with Team Mesa. With the CF-18 MTT prototype on track for inspection, acceptance, and delivery, AFRL and DRDC also agreed to pursue development of a second CF-18 to support Coalition Mission Training Research (CMTR) with a two-ship fighting element.

An International Project Arrangement under The Technical Cooperation Panel, *Coalition Mission Training Using Distributed Simulation*, was signed by representatives of the US, Canadian, and UK governments for semi-annual CMTR

Mr. Dave Greschke, DMO Testbed Manager, describes M&S technologies and methods developed at MRS for warfighter training to Lt Gen John Hopper, Vice Commander, Air Education and Training Command (AETC), with Col Curt Papke, MRS Commander, and Brig Gen Steve Sargeant, AETC Director of Plans and Programs



trials linking simulation sites in these countries. MRS also secured an International Project Arrangement for *Collaborative DMT Effectiveness Research* with Australia’s Defence Science and Technology Office (DSTO). This research effort is funded by the Secretary of the Air Force International Affairs office under the International Cooperative Research & Development Program (Nunn funds). These trials are crucial in the spiral development process designed to leverage engineering successes, build compatible DMO systems, and define training strategies to enhance coalition warfighting skills.

Following successful CMTR trials in November 2001 and February 2003, the upcoming CMTR event will incorporate the MRS-developed CF-18 MTT technology demonstrator after bed-down at DRDC-Toronto. A secondary CMTR objective will be to refine engineering systems and processes for conducting distributed mission planning, briefing, replay, and debriefing.

Basic Research Advances M&S Science Foundation for Warfighters

During the 5th International Conference on Cognitive Modeling in Bamberg, Germany, the Division’s Performance and Learning Models (PALM) team presented a paper and conducted a symposium on computational cognitive process modeling of Predator Uninhabited

Aerial Vehicle (UAV) operators. Exchanging information on state-of-the-art cognitive model development and evaluation, the PALM team earned the Siegel-Wolf Award for their high quality empirical research and cognitive model of the UAV operator.

Although international recognition underscores the Division’s scientific leadership, the PALM team’s efforts are designed to realize the relevance and potential for transitioning M&S technologies and methods on a broad front to support the Air Force’s warfighting mission. The team lead chaired the three-day international 12th Conference on Behavior Representation in M&S (BRIMS) 2003, which was sponsored by AFRL, the Army Research Laboratory, Defense Advanced Research Projects Agency, Defense M&S Office, National Air and Space Administration, and the Office of Naval Research. The keynote speaker, Dr. Robert Foster, Director of Bio-Systems within the Office of the Director, Defense Research and Engineering, confirmed behavior representation research is critical to DoD’s goals of using M&S to gain insight into and predict warfighter actions.

In addition to basic research topics addressed at BRIMS, applied research experts guided scientists and engineers from three services to identify requirements for distributed mission debriefing systems. The Division’s DMO training research program includes a digital distributed briefing and debriefing system using commercial-off-the-shelf technology.



AF M&S Caucus members observe F-16 pilots and a Weapons Director execute 4-ship scenarios in Mesa’s DMO Testbed



With the UAV model in the background, PALM Lab team members proudly display their Siegel-Wolf Awards for cognitive research supporting DMO warfighter training. From left (seated), Dr. Kevin Gluck (Team Lead) and Mr. Michael Krusmark, (standing) Lt Col Stu Rodgers (MRS Deputy), Dr. Jerry Ball, and Lt Matthew Purtee

gies, which will ultimately include intelligent agents and behavior representations to enhance effectiveness and utility of these systems as a warfighting tool.

Training Technologies Meet CAF Needs

In early 2003, an Urgent Request to add LITENING II Targeting Pod training capability in A-10 FMTs ignited swift action at MRS. Air Force Reserve Command (AFRC) F-16 MTTs and the Air Combat Command (ACC)/Air National Guard (ANG)/AFRC A-10s were built using the common set of open-architecture hardware and software MTT design conventions developed by Team Mesa and transitioned to commercial support. This design aligns with M&S goals described by AF/XI regarding development cost avoidance, savings on operating costs, and increasing mission capability.

The non-proprietary, open-architecture plug-and-play common core MTT/FMT design developed at MRS guaranteed unprecedented fulfillment of the Urgent Request at very low cost. Team Mesa exercised the advantage of previously facilitating low-cost LITENING pod upgrades for AFRC F-16 MTTs and successfully coded, tested, and fielded the first software

for the LITENING simulation in the AFRC A-10 FMT at Whiteman AFB MO--within 30 days and an approximate cost of \$20K. Team Mesa's unprecedented ground-breaking efforts enabled industry to expeditiously field LITENING II pod simulation capability to other A-10 sites prior to *Operation Iraqi Freedom* deployment.

Responding to another request during *Operation Iraqi Freedom*, MRS quickly acquired and delivered substantial amounts of critical source data for the 1st Marine Expeditionary Unit (1st MEU) prior to deployment. Mesa's lead image and database expert orchestrated actions to meet the 1st MEU's request for a deployable PC-IG capability to enable area familiarization. Along with more than 1,000 high-resolution classified overhead images, the engineer supplied several other types of source data and facilitated rapid development and delivery of a large Southwest Asia photospecific simulator database. With classified and unclassified database versions of Iraq in hand, the 1st MEU conducted mission rehearsal scenarios while enroute and after arrival in-theater.



The A-10 FMT, designed at MRS with open-architecture and common core software, enabled delivery of LITENING II Targeting Pod simulation capability "cheaper, better, faster" to front-line "Hawg" units prior to *Operation Iraqi Freedom*

Acting on Chief of Staff of the Air Force direction, the Division stood up a Joint Close Air Support (JCAS) training research team to orchestrate R&D efforts providing immersive Terminal Attack Control (TAC) training capability. Fueled by ongoing Mission Essential Competency (MEC) research, the JCAS efforts apply MEC-based simulation training methodologies as templates to improve TAC skills.

The close proximity of Nellis AFB, "Home of the Fighter Pilot," led to Mesa's strong ties with Air Warfare Center (AWFC) customers such as the Nellis Combined Air and Space Operations Center, the 98th Range Wing, and the USAF Weapons School. The Division also had prior collaborative relationships with several organizations now under AWFC, including the Theatre Aerospace Command and Control Simulation Facility (TACCSF) at Kirtland AFB NM and the USAF C2 Technology Innovation Group at Hurlburt Field FL. Beginning with the Air Ground Operations School (AGOS) at Nellis AFB, program synergies have triggered actions to establish cooperative agreements aimed at advancing mission readiness training.

Working with AGOS, MRS researchers and engineers provide crucial expertise in the effort to produce the first prototype Forward Air Control (FAC) trainer. An early effort provided a cutting-edge FAC simulation in less than 60 days, realistically immersing TAC students and advancing AGOS training goals by 100 percent.

Team Mesa's leadership in M&S technologies is grounded in basic and applied training research that maximizes combat mission effectiveness. Mesa's progressive approach to research and development of training technologies and methods melds live, virtual, and constructive DMO assets to enable warfighters to effectively "train the way we fight."





Dr. Henk Ruck (center), newly appointed Director, Human Effectiveness Directorate, helped Team Mesa host Mr. Barry Hennessey (left), Director, Security and Special Programs Office under Mr. William Davidson, Administrative Assistant to SECDEF, and showcase collaborative M&S programs supporting warfighter operations

The MRS “Fly by Night” team also performed spectral emission scan measurements of an F-16 Block 30/32 Head-Up Display (HUD) on the test bench in the 302nd

BRIEFS & DEBRIEFS

The Division delivered an upgraded **Night Vision Training System (NVTS) SensorHost** unit to Marine Corps Air Station (MCAS) Cherry Point NC. An MRS-developed NVTS has significantly enhanced NVG training capabilities for USMC AV-8B Harrier pilots at MCAS-Yuma. The upgraded unit for the MCAS-Cherry Point simulator enables “naked eye” night vision or high-fidelity NVG imagery to support training for night operations.

The Division’s US Navy liaison organized a multimedia DMO training research presentation to the **US Joint Forces Command (USJFCOM) Component Commanders’ Conference** at NAVAIR Orlando FL. The presentation accentuated successful international DMO trials and tied the Division’s R&D programs for day/night integrated readiness training, to real-world coalition operational needs (e.g., *Operation Iraqi Freedom*).

TARGETS OF OPPORTUNITY

A collaborative effort between MRS and CHI Systems, Inc., Orlando FL to improve adaptive tactical team mission planning and execution will yield a CAF training system designed for use in DMO exercises and F-16 MTCs. The Cognition-Centered Constructivistic Program of Instruction (C3PI) will help aircrews visualize execution of tactics and facilitate acquisition of richer and more comprehensive tactical knowledge. An F-16 SME with Iraq combat experience will apply tactics, scenario development, and presentation expertise to improve interface usability for C3PI.

MRS night vision device experts responded to a request from ACC and Warner-Robbins Air Logistics Center to perform a baseline assessment of HC-130P cockpit instrument illumination. The MRS team evaluated how light from chemical light-sticks affected Night Vision Goggle (NVG) operation, as well as NVG compatibility of two new cockpit multi-purpose color displays. The assessment and testing at the Naval Air Systems Command (NAVAIR) facility at Lakehurst NJ will lead to improved integration of cockpit lighting and NVGs for the C-130 Combat Search and Rescue mission.

Fighter Squadron’s avionics test facility and in a jet at nearby Luke AFB AZ. The team assessed visibility of an F-16C Block 30 HUD to determine why difficulty in reading the HUD with model F4949G NVGs occurs, unless the brightness is set to an unacceptable high level.

The High Energy Laser (HEL) model, designed to emulate future laser weapons mounted on fighter aircraft pods, now runs in all four Vipers at MRS. Collaborating with the AFRL Directed Energy Directorate and TACCSF, Team Mesa will apply extensive DMO training research expertise to define the training Concept of Operations for the HEL Fighter. Multi-ship tactics, techniques, and procedures will also be defined while this advanced Major Defense System is under development.



MRS representatives brief DMO and night vision training research to the USJFCOM Commander and Commanders of Army Forces Command, Marine Forces Atlantic, US Atlantic Fleet, and Air Combat Command (COMACC)



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